GCE AS/A Level – LEGACY

HUMAN BIOLOGY – HB2

MONDAY, 4 JUNE 2018 – AFTERNOON

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this examination paper you will need a ruler and a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

For Examiner’s use only

<table>
<thead>
<tr>
<th>Question</th>
<th>Maximum Mark</th>
<th>Mark Awarded</th>
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<td>Total</td>
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1. Cell structure has been used to classify organisms into different kingdoms. Some characteristics of different cells are listed below.

A  mesosomes present
B  genetic material made of DNA
C  cell wall outside cell membrane
D  centrioles present
E  photosynthetic pigments on thylakoids
F  80S ribosomes attached to endoplasmic reticulum

(a) (i) Using the letters (A-F), complete the Venn diagram below to compare and contrast plant, animal and bacterial cells.

PLANT CELLS

BACTERIAL CELLS

ANIMAL CELLS

(ii) Explain why bacterial cells are prokaryotic while plant and animal cells are eukaryotic.
(b) Penicillin is an antibiotic produced by the fungus *Penicillium notatum*.

(i) Fungi are eukaryotic but are classified into a different kingdom from plants. Explain why. [1]

(ii) Explain how penicillin causes the death of bacteria. [3]

(iii) Explain why penicillin kills bacteria but not plant or animal cells. [2]
2. The human digestive system shows a number of adaptations that increase the efficiency of obtaining nutrients.

(a) Explain the following adaptations:

(i) Long small intestine; [2]

(ii) Different pH in mouth, stomach and small intestine. [2]

(b) Image 1 below shows the appearance of the wall of the small intestine and Image 2 shows a close up of the surface of the cell labelled S in Image 1.
(i) Name the structure shown in Image 1. [1]

(ii) Name the structure labelled R in Image 2. [1]

(iii) Explain how these structures also help to increase the efficiency of obtaining nutrients. [1]

(iv) State the role of the following in the absorption of nutrients. [2]

   P ............................................................................................................................................................................................

   Q ............................................................................................................................................................................................

(c) Coeliac disease is caused by an allergy to gluten. State one difference you would observe in the wall of the small intestine of a person suffering from Coeliac disease and explain how this could affect a person's energy levels. [3]
3. Gas exchange in humans takes place in the alveoli. The photograph and diagram show the structure of an alveolus.

(a) (i) Identify cells A and B. [2]

A ........................................................................................................
B ........................................................................................................

(ii) Complete the table below to identify and explain two adaptations of alveoli that increase the efficiency of gas exchange. [4]

<table>
<thead>
<tr>
<th>Adaptation</th>
<th>Explanation</th>
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(b) The graph below shows a spirometer trace.

(i) Name the lung volume measurement marked \( V - V_1 \) on the graph. 

..........................................................................................

(ii) Describe how this would differ in a person suffering from asthma.

..........................................................................................

(iii) The line marked \( x \) shows the volume of oxygen consumed during period \( y \). Calculate:

I. the breathing rate during period \( y \) on the graph.

\[
\text{breathing rate} = \ldots \text{breaths s}^{-1}
\]

II. the rate of oxygen consumption.

\[
\text{rate of oxygen consumption} = \ldots \text{dm}^3 \text{ s}^{-1}
\]
4. Parasites are described as being organisms that live in or on another organism. *Schistosoma mansoni* is a species of trematode worm that lives in the blood vessels of the liver and small intestine.

![Image of Schistosoma mansoni](image)

(a) Suggest one way in which the adult worm is adapted to its habitat. [1]

(b) Large numbers of eggs are passed out of the small intestine in the faeces of an infected human.

(i) Explain why large numbers of eggs are produced by the female worm. [1]

(ii) Suggest how the release of the eggs into the small intestine could lead to anaemia. [2]

(iii) In water, the eggs hatch and a larval form infects a secondary host. Name the secondary host of *S. mansoni*. [1]
(c) Adult *Schistosoma mansoni* have a simple gut. Adult *Taenia solium* tapeworms that live in the small intestine do not.

Suggest a reason for this difference between these types of parasite. [2]
5. There are two main proteins found in humans that can bind to oxygen, haemoglobin and myoglobin. The graph below shows the oxygen dissociation curves for human haemoglobin and myoglobin at rest.

(a) (i) From the graph, find the pO$_2$ that results in 50% dissociation of:

- myoglobin .......................................................... [2]
- haemoglobin .......................................................... 

(ii) What does this tell you about the relative oxygen affinities of these proteins? [1]

(iii) Explain how this enables myoglobin to act as an oxygen store in muscles. [2]
(b) (i) During the first six months of pregnancy, foetal haemoglobin has 50% dissociation at approximately 2.5kPa. **On the graph opposite, draw a line to represent the dissociation curve for foetal haemoglobin.**

(ii) By birth, foetal haemoglobin is almost completely replaced by adult haemoglobin. Explain why it would be a disadvantage to a baby if it were born with foetal haemoglobin rather than adult haemoglobin.

(c) The table below shows how increasing levels of carbon dioxide (pCO₂) in the blood plasma affect the partial pressure of oxygen (pO₂) at which there is 50% dissociation of haemoglobin.

<table>
<thead>
<tr>
<th>pCO₂ / kPa</th>
<th>pO₂ at which there is 50% dissociation of haemoglobin / kPa</th>
</tr>
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<tbody>
<tr>
<td>0.6</td>
<td>3</td>
</tr>
<tr>
<td>2.7</td>
<td>3.5</td>
</tr>
<tr>
<td>5.3</td>
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<td>8.7</td>
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<td>13.3</td>
<td>4.4</td>
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(i) Under what conditions will the level of carbon dioxide in blood plasma increase?

(ii) Name and describe the relationship between pCO₂ and the pO₂ at which oxyhaemoglobin dissociates.

Name:

Relationship:
(iii) Explain the advantage of this relationship to a human.
6. **Answer one** of the following questions.

Any diagrams included must be fully annotated.

**Either, (a)** Explain how vaccination can prevent infection. Discuss the effectiveness of vaccination against different diseases and the issues which must be considered when developing vaccination programmes. \[10\]

**Or, (b)** Describe how humoral and cell mediated responses defend the human body against infection. \[10\]